times after several days, a whirl begins at the westerly end of this band, and the whole system resolves itself into a "low" with its whirling winds.

A close analogy is found between these bands of opposing winds and the case quoted in the preceding note, where cold, moist air from the ocean was flowing inward on the New Jersey coast, while at the same time, according to the weather map, a cold, dry, northwest wind was blowing from the interior over this region. The northeast ocean wind, having a temperature of 15° to 22° F., was mixing with the northwest land wind, having a temperature of about 0° F., judging from the isotherms of the morning weather map, producing the minute snowflakes described by Mr. Gray. It is to be regretted that the exact temperature, moisture, and wind could not have been observed by Mr. Gray, with the help of kites, at various elevations. The layer of northeast wind seems to have extended above the buildings in his neighborhood, but the weather map shows that the dry, cold wind must have been present, probably as a very gentle upper wind from which cold air descended in little streaks, just as we see in an area of high pressure and clear blue sky on a summer day, when air comes down in little gusts, spreading outward as they strike the ground, carrying the dust before them as the wind rolls along the ground.—*C. A.*

PREVENTION OF DAMAGE BY FROST.

By ROBERT P. SKINNER, U. S. Consul General, Marseilles, France. Dated January 25, 1906.

No general attempt is being made in France to prevent the destructive influence of frost in the vine-growing regions. The traditional method of waging warfare against such influences is by creating a dense smoke, caused by burning damp straw, but the process is expensive and of doubtful efficacy. Several proprietary compositions, intended to perform efficiently the work inadequately performed by burning straw, are upon the market, but their sale has been kept back by the low prices which common table wines now bring, so low, indeed, that wine growers would rather see their crop damaged than spend any considerable amount of money to prevent it. Nevertheless many proprietors of advanced ideas, and especially such as produce expensive kinds of wine, are making what seems to be an increasing market for the smoke producing preparations offered for sale. The officers of the best known company in this business inform me that they took hold of the "Fumigène Mortier" about five years ago, and though they have not advertised it publicly, they say that this branch of their very large business is steadily increasing, and that within the last three years they have themselves disposed of 20,000 boxes in France alone. This would mean, in a period of three years, about 2000 hectares (4942 acres) treated. In 1903, 1500 boxes were sold by the same company in Smyrna, after which the Turkish Government put a stop to the importation, on the ground that the boxes contained nitrate of potash. I have no knowledge in regard to the commercial success of other devices, all of which appear to have been subjected to numerous tests in the presence of official and semiofficial committees.

From the account of one such test, which took place on May 21, 1900, near Auxerre, in charge of M. Méras, Director of the Society for the Reconstitution of French Vineyards, I take the following paragraphs:

> The experiments took place with different systems, industrial and natural, permitting the production of artificial clouds, which in their turn prevent the radiation which causes frost, and thereby prevent the killing of the buds. Let us first explain how frost is produced by radiation.
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> Dew is deposited on a body when the latter, having allowed to escape during the night a portion of the solar heat received during the day, becomes so chilled by radiation as to lower the temperature of the adjacent air, and bring about a state of saturation. From that instant, if the air continues to become colder, the vapor which it contained is condensed in the form of dew. A white frost is produced when the temperature of the bodies on the surface of which the dew is formed is low enough to cause the dew to congeal. When a body is sheltered by cloths, straw-matting or natural clouds, the deposit of surface dew is light. As the radiation takes place in every direction, the heat radiated from the surface is reflected back by the shelter, whereby the chilling process is not sufficiently pronounced to result in a white frost.
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> M. Méras proceeded to the successive lighting of the different combustibles prepared for the purpose of forming clouds. He first experimented with pots containing exactly 7.5 kilograms (16.5 pounds) of coal tar, this weight corresponding to those of the boxes bearing the names of Maydieu and Lestout, both manufactured at Bordeaux, and the "Fumigène Mortier," manufactured at Marseilles. The smoke produced by the coal tar proved to be black, and formed a screen less able to prevent radiation than that produced by a white smoke. The intensity of the smoke was increased by sprinkling water upon the tar by means of a broom. The first composition burned two hours, and it was judged that the boxes, placed at distances of 20 meters (65.61 feet) from each other, should have been separated by not more than 10 meters (32.80 feet). The fact that the buds appeared to be blackened after this operation need alarm no one, as this blacking is due simply to the deposit of soot. After these experiments with coal tar, the industrial preparations were taken up.
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> The Lestout composition consisted of a square pine box, containing 7.5 kilograms (16.5 pounds) of residue from the manufacture of rosin. The boxes cost 1 franc (19.3 cents) each. The smoke, as black as in the first case, appeared to be heavier and rose less than that of burning tar. The period of combustion was one hour and a half. These boxes have the inconvenience of taking fire, and by their disaggregation they thus allow the contents to escape and burn upon a considerable surface, thus abridging the duration of the protecting cloud.
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> The Maydieu box was next lighted, and gave the same results as the Lestout box, except that the period of combustion was longer. In both cases the intensity of the smoke is susceptible of being increased by covering the boxes with moss or dampened straw.
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> The commission next experimented with boxes of dampened sawdust, mixed with bunches of green moss, straw manure, and damp straw. It required a considerable time to start the fires; but although these boxes gave a whiter smoke, it proved to be insufficiently dense to be really efficacious. By dosing the mixture with tar a more abundant smoke was obtained. These natural combinations, which are economical enough, have the disadvantage of proving useless in case of an abundant rain falling upon them during the night or even several days prior to the period of use. Small proprietors, however, who wish to avoid expense, may utilize them.
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> The commission finally took up the newly invented preparation known as the "Fumigène Mortier" from Marseilles. This preparation was packed in boxes containing about 4 kilograms (8.8 pounds) of black powder, the boxes selling at 1.50 francs (29 cents) each. In the middle of the cover of the box a hole is made before the "Fumigène" is put in place. When the time comes to produce the smoke, the material is lighted from this hole, whereupon the box is turned over with the hole upon the earth. This being done by the commission, a very intense and very abundant smoke was immediately produced. This yellowish smoke formed a veritable cloud, constituting a powerful screen over the vineyard to be protected. This smoke remained in place longer than any smoke previously produced, in spite of a fairly strong wind. Had there been no wind, and there is none when frosts occur, it is certain that this smoke would remain in place long enough to prevent any white frost. According to the opinion of all present, the "Fumigène Mortier" gave the best results.

Since the original experiments were made along these lines the manufacturers claim to have perfected the composition, and they suggest an elaborate system of electrical wires connecting various parts of large estates with headquarters in such manner that when registering thermometers, set up in the vineyards, fall to the danger point, an alarm bell rings in headquarters, whereupon the overseer arouses his employees, and starts the protecting fires. M. Justin Lieutaud, of the Mas de l'Ange, Camargue, possesses such an installation, which protects 30 hectares (74.13 acres). My information in regard to M. Justin Lieutaud's equipment is dated five years ago, and I have no information in regard to his experience since.

It is to be remarked that frost-fighting methods are still in an uncertain and tentative stage. Reports in regard thereto, as well as in regard to efforts to counteract the processes of nature concerning rain and hail, are accepted with skepticism, and I do not myself wish to be considered as indorsing any process described. On the other hand so much is claimed, and the materials spoken of are so cheap, that American farmers can readily take the matter up on their own account.

Consular Agent Jouve, at Toulon, who has important vineyards of his own and whose experience I solicited, writes as follows:

Many experiments have been made in this region to protect vineyards against frost. The method of burning tar and other combustibles with a view to producing a dense smoke when frost is anticipated, is not specially efficacious, and is difficult, as fires must be lighted at the same time at a great number of places throughout the vineyard. To succeed well by the production of smoke, the vineyards should be located in the valley, and any wind will prevent the success of the experiment. In some districts the evil effects of frost are counteracted by leaving the branches uncut until the end of the cold season. By this method, if the terminal bud of the growing branch be frozen, the succeeding buds are unharmed. This, however, is a method which takes too much of the sap of the vine. In conclusion, all the processes of which I have heard are of uncertain practical value.

I have also the following information from Mr. F. Richter, a gentleman of large experience residing at Montpellier, in the heart of the wine-growing region:

The methods now known of preventing damage by frost are not always efficacious, and when the temperature falls below 4° or 5° C. (39° or 41° F.) at the level of the young shoots, the cases are rare when the method regarded as most efficacious provides a sufficient protection. The radiation of plants is diminished very sensibly during clear nights by the distribution of white powder upon the leaves, and the effect is the more pronounced in proportion as the green organs intended to be protected are the more evenly covered. This method has never been generally adopted, and it may be said at present that the method of fighting the frost most frequently employed is the creation of clouds of smoke.

In the vineyards the owners establish low piles of vine shoots mixed with brush and covered with earth, or perhaps straw mixed with green plants of all sorts, capable of forming a great deal of smoke. The intensity of the smoke is increased by sprinkling water upon the earth during combustion. Still more commonly, however, land owners make use of manufactured preparations such as the Lestout box and the Fumigène Mortier. These preparations are lighted generally in the morning, when the temperature is reached at which white frost is formed, and they are kept burning until after sunrise, so as to delay the thawing, which is as bad for the plants as the frost itself.

My California correspondent, who seeks this information, says that he has heard of the shooting of chemicals over vineyards, a process concerning which I have no information. The Reveil Agricole, published on January 21, 1906, refers to the use of chemicals for the purpose of overcoming the damage by frost, not by shooting the same over the vines and trees, but in the form of a fertilizer. This article says that experiments have been made with potassic fertilizers upon several fields of wheat. After a rigorous winter the parcel of ground untreated gave a crop less than one-half of that yielded by fields which had not suffered from cold, while another parcel of land which had been frozen and which had also been treated with this fertilizer gave a normal crop. M. Laroux, the Professor of Agriculture at Marseilles, reports that in a nursery at Gotha, Germany, the use of 400 kilograms, (881.84 pounds) of chloride of potassium per hectare (2.47 acres) saved all the trees from frost in 1900–1901, while trees not so treated were decimated in the proportion of from 10 to 20 per cent. The Reveil Agricole adds that this is not a simple coincidence, and that there is a specific and very curious action of potassic salts of which the writer does not pretend to know the explanation. At Dreux, on an experimental farm, parcels of wheat and lucerne which had not been treated with potassium were feeble and unsatisfactory after a hard winter, while on the same farm wheat and lucerne which had been given this chemical treatment were much more vigorous.

EARLY KNOWLEDGE OF THE TIDES AT PANAMA.

By R. A. HARRIS, of the Coast and Geodetic Survey. Dated Washington, D. C., March 19, 1906.

In Chapter IX of his Sumario de la Natural Historia de las Indies which was published in 1526, Oviedo y Valdez makes the first mention of a question which has continued to be of interest down to the present time, viz, the smallness of the tides in the Caribbean Sea and the greatness of the tides on the Pacific coast of Darien.

He compares the tides in the Caribbean Sea to those of the Mediterranean, and the tides on the Pacific coast to those found on the western coast of Europe; for the great difference between the tides of the ocean and of the Mediterranean was a fact known to geographers since the time of Aristotle. Equally long ago had the conclusion been reached that large tides, as a rule, belong to large seas.

In Oviedo's time the movements of the ocean were commonly ascribed to the westward motion of the primum mobile so that—

"*Ad coeli motum elementa (excepta terra) moventur.*"

However, Josephus Acosta (1539?–1600) considers the water to be too closely connected with the earth to partake of this general movement (Purchas his Pilgrimes, Vol. III, page 924); but in his remarks upon the tides he does not suggest any universal cause. (Ibid. pp. 929, 930.)

It seems from Oviedo's mention of the Mediterranean tides that he regards them as entirely derived from those in the Atlantic.

As a matter of fact, recent observations and study prove that the western portion of this sea is governed by the Atlantic in somewhat the manner indicated by Oviedo, while the eastern portion, from Sicily to the Levant, has a rise and fall of its own and is tidally independent of the Atlantic.

The small tides along the northern shores of Darien are due to the equilibrium tide of the western portion of the Caribbean Sea, while those of the eastern portion of this sea, although small, are derived from the Atlantic. The passages between the Lesser Antilles are numerous and often large; but the smallness of the outside rise-and-fall prevents the derived tide from being large in the Caribbean waters. This smallness of the outside ocean tide is due to the fact that a nodal line of a stationary oscillation extends from near the island of Guadeloupe in a northeasterly direction.

The large tides off Gibraltar and the port of Panama are due to the fact that a loop of a fundamental oscillating system lies near each of these two localities.

The semidaily range of tide at Panama is 12.6 feet, while at Colon it is but 0.6 foot.

It happens that when it is high or low water at Panama it is very nearly half tide level at Colon, and vice versa.

My attention was called to Oviedo y Valdez's account of the tides by Professor Abbe, who recently sent me a tentative translation of a few sections of the Sumario, made by Miss F. Isabelle Wilbur.

An English translation of extracts from the Sumario is given by Purchas in his Pilgrimes, Vol. III. That relating to the tides occurs on page 989, and is substantially the same as the matter just referred to, and reads as follows:

Of the increase and decrease (that is) rising and falling of our Ocean Sea, and South Sea, called the Sea of Sur.

I will now speake of certaine things which are seene in the Prouince, or at least in the Citie of *Golden Castile*, otherwise called *Beragua*, and in the coasts of the North Sea, and of the South Sea, called the Sea of *Sur*, not omitting to note one singular and maruellous thing which I haue considered of the Ocean Sea, whereof hitherto no Cosmographer, Pilot, or Mariner, or any other, haue satisfied me. I say therefore, as it is well knowne to your Maiestie, and all such as haue knowledge of the Ocean Sea, that this great Ocean casteth from itselfe the Sea *Mariterraneum* by the mouth of the Straight of *Gibralterra*, in the which the water, from the end and furthest part of that Sea, euen vnto the mouth of the said Straight, either in the East toward the coast commonly called *Leuante*, or in any other part of the said Sea *Mediterraneum*, the Sea doth not so fall or increase, as reason would judge for so great a Sea, but increaseth very little, and a small space: Neuerthelesse, without the mouth of the Straight in the mayne Ocean, it increaseth and falleth very much, and a great space of ground from sixe houres to sixe hours, as in all the coasts of *Spaine*, *Britaine*, *Flanders*, *Germanie*, and *England*. The selfe same Ocean Sea in the firme Land newly found, in the coasts of the same lying toward the North, doth neither rise nor fall, nor likewise in the Ilands of *Hispanola* and *Cuba*, and all the other Ilands of the same lying toward the North, for the space of three thousand leagues, but onely in like manner as doth the Sea *Mediterraneum* in *Italie*, which is in manner